Massively Parallel Processing

Transforming massively parallel computing into production use for tremendous performance gains

Modern high-performance microprocessor technology has spurred the development of a new form of very-high-performance computer, the massively parallel processor (MPP). In this approach, large numbers of processors divide the components of a problem into tiny fragments, each processor working on a different fragment at the same time. In recent years, microprocessors have made tremendous gains in performance, challenging the big machines at a fraction of the cost.

We are working to transform massively parallel computing into production use. We expect this approach to deliver a new computational capability to scientists and engineers at LLNL during the next few years.

The Livermore Model

Through our experiences with MPP architectures, we have developed a migration strategy from our current environment to a massively parallel environment—known as the Livermore Model. In this model, MPPs can be used in capacity mode (processing large numbers of serial jobs) as well as in capability mode (processing single or several highly parallel applications.) In addition, the system must support multiple parallel programming styles within a single application.

Technology

To support the Livermore Model, we are dramatically extending the notion of our Production Control System (PCS), upgrading it to handle a large number of distributed nodes (processing elements) and the notion of node conglomeration (machine partitions). In addition, we are working with several vendors and academic collaborators to build a set of scalable (massively parallel) algorithm development and analysis tools. These tools focus on the task of integrating several parallel programming paradigms in a single application framework.

Availability: We are currently using the MPP primarily in a capacity mode with a small number of parallel applications. We will then apply MMP to key applications that would benefit most from increased capability.

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APPLICATIONS

- In medical treatment models to develop new planning techniques for radiation oncology treatments

- In oil well logging to more accurately calculate the geology around oil wells

- In defense sciences to develop increasingly complex physics models of nuclear explosives

- In earth system modeling to predict long-term climate changes